

VUKSIC, L. and OTHERS<sup>a</sup>

"Some Problems of the Epidemiology of Exanthematous Typhus in Sandzak, Bosnia, and Hercegovina in the Years 1951-1952." p. 23. (Vojnosanitetski Pregled. Military-Medical Review, Vol. 10, no. 1/2, Jan/Feb. 1953. Beograd)

SO: Monthly List of East European Accessions, Vol. 3, no. 3. Library of Congress. March 1954.  
Uncl.

VUKSIC, L.J.; MORELJ, M.; ZDRAVKOVIC, A.; MIHOJCIC, B.

A plan for the prevention of communicable diseases in Serbia.  
Higijena 15 no.1/2:16-34 '63.

VUKSIC, Ljubomir, puk.dr

Migration of the civilian population during the war. Bibl.Hig.inst  
Srbije, no.5:180-194 '54.

Bibliografija Higijenski  
INSTITUT  
SRBIJE

1. Katedra na higijeny i epidemiologiju Vojno-medicinske akademije  
JNA.

(WAR,  
migration of civilian population during war)  
(TRANSIENTS AND MIGRANTS,  
migration of civilian population during war)

VUKSIC, Lj.; ARSIC, B.; MEL, D.; MORELJ, M.; GERBEC, M.; MILOVANOVIC, M.;  
STOJKOVIC, Lj.; MIRKOVIC, M.; MILIVOJEVIC, M.

Isolation of *Coxiella burnetti* from stable dust. Higijena,  
Beogr. 8 no.4:240-245 1956.

1. Katedra za Higijenu i epidemiologiju VMA. Virusološko  
odjeljenje Higijenskog instituta NRS, Beograd.

(COXIELLA BURNETTI,

isolation from stable dust (Ser))

(DUST,

isolation of *Coxiella burnetti* from stable dust (Ser))

MORELIJ, Marijan; GERHARD, Miro; VRSIC, Ljubomir; MML, David

Q fever; isolation of Coxiella burnetti from sheep placenta. Voj.  
san. progl., Beogr. 14 no.5:255-260 May 57.

1. Katedra za higijenu i epidemiologiju VMA Bakteriološki i  
mikrobiološki institut.

(Q FEVER, microbiol.

isolation of Coxiella burnetti from sheep placenta (Q fever)

(SHEEP

name)

VUKSIC, Ljubomir, sanitetski pukovnik, profesor dr.; ARSIC, Bogoljub,  
sanitetski pukovnik, docent dr.; KOPPELJ Marijan, general-major  
sanitetske službe profesor dr.

Development of the military epidemiologic doctrine on dysentery  
in the Yugoslav National Army. Vojnosanit. pregl. 22 no.6:365-  
370 Je '65.

1. Vojnomedicinska akademija u Beogradu, Higijenski zavod,  
Epidemioloski institut.

MORELJ, Marjan, general-major sanitetske sluzbe profesor dr.;  
ANDELKOVIC, Dragana, dr.; VUKSIC, Ljubomir, sanitetski  
pukovnik profesor dr.

Some epidemiologic aspects of diarrheal diseases in  
Yugoslavia. Vojnosanit. pregl. 22 no.6:371-380 Je '65.

1. Vojnomedicinska akademija u Beogradu, Higijenski zavod,  
Epidemioloski institut, Savezni zavod za zdravstvenu zastitu.

VUKSIC, Ljubomir, sanitetski pukovnik, prof. dr.; JOVANOVIC, Tihomir, sanitetski major, dr.; NIKOLIC, Bozidar, sanitetski potpukovnik, dr.

Sterilization of syringes by boiling for the TABT vaccination in the Yugoslavian Army and its influence on infectious hepatitis. Vojnosanit. pregl. 21 no.5:344-349 My '64

1. Vojnomedicinsku akademija u Beogradu.



BIRTASEVIC, Bozidar, sanitetski major, dr.; BICAKCIC, Halim, sanitetski  
pukovnik, dr.; VUKSIC, Ljubomir, sanitetski pukovnik profesor, dr.

Explosive epidemic of inoculation hepatitis. Vojnosanit. pregl. 21  
no. 5:322-325 My '64

VUKSIC, Ljubomir, sanitetski pukovnik, prof.dr.

A method for teaching military epidemiology. Vojnosanit. pr. 20  
no.9:577-585 9 '63.

S

VUKSICH,

YUGOSLAVIA/Virology - Human and Animal Viruses.

E-3

Abs Jour : Ref Zhur - Biol., No 4, 1958, 14613

Author : Vuksich, Arsich, Mel, Morel, Gerbets, Milovanovich,  
Stoykovich, Mirokovich, Milivoevich.

Inst : -

Title : Isolation of Coxiella Burneti From Dust of Sheep Corrals.

Orig Pub : Higijena, 1956, 8, No 4, 240-245

Abstract : No abstract.

Card 1/1

USCOMM-DC-55, 112

VUKSIC, L.J.

Contribution to the geographic distribution of Q fever in Yugoslavia.  
Higijena, Beogr. 12 no.2/3:165-177 '60.  
(Q FEVER epidemiol)

ZAPESOCHNYY, I.P. [Zapishochnyi, I.P.]; ZHUKOV, I.G. [Zhukov, I.H.];  
GARGA, I.I. [Harha, I.I.]; VUKSTICH, V.S. [Vukstych, V.S.]

Apparatus with a vacuum monochromator for studying optical  
excitation functions. Ukr. Fiz. zhur. 9 no.2:196-206 F'64  
(MIRA 17:7)

1. Uzhgorodskiy gosudarstvennyy universitet.

ACCESSION NR: AP4017398

S/0185/64/009/002/0196/0206

AUTHOR: Zapisochnyy, I. P.; Zhukov, I. G.; Garga, I. I.; Vuksty\*ch, V. S.

TITLE: Vacuum monochromator for the investigation of optical excitation functions

SOURCE: Ukrayins'kyy fizy\*chnyy zhurnal, v. 9, no. 2, 1964, 196-206

TOPIC TAGS: vacuum ultraviolet, vacuum ultraviolet spectroscopy, resonance level excitation cross-section, excitation cross-section, resonance radiation, ultraviolet monochromator, vacuum monochromator, electron beam excitation tube, mercury resonance lines

ABSTRACT: There are practically no data at present on the effective excitation cross sections of resonance levels of atoms, diatomic molecules and their ions of various multiplicity, owing to experimental difficulties in the vacuum ultraviolet region of the spectrum.

To obtain such data the authors have constructed a spectrophotometric set-up, consisting of three basic units: a vacuum monochromator of normal incidence with a one-metre (600 lines/mm) standard concave diffraction grating;

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ACCESSION NR: AP4017398

highly monoenergetic electron beam excitation tubes; an electrophotometer using a secondary electronic multiplier (SEM) in a pulse counting regime for recording radiation in the vacuum ultraviolet region.

The monochromator was designed so that the refraction grating and rigidly attached input and output slits are always on the Rowland circumference. Transmission of movement in the vacuum is accomplished through bellows, while the kinematic system ensures linearity of the graduated graph throughout the working region (800-3500 Å).

The luminous vertical gas column in the excitation tube may be precisely set on the input slit under control of a distance gauge consisting of two telescopes, for which the possibility of moving part of the monochromator housing from the input slit is provided. This permits the maximum utilization of the light power of the monochromator (the loss in resolving power is negligible, since the intervals between the spectral lines are considerable for most objects).

The open type SEM, together with the voltage divider and the cathode repeater are located directly behind the output slit of the monochromator in a special shell. The pulse count is taken with the aid of a standard "Tulip" velocity meter.

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ACCESSION NR: AP4017398

The block diagram and the external appearance of the spectrophotometric set-up are shown in the appended drawings.

In conclusion, tentative data are given on the excitation functions of mercury lines  $\lambda=1850 \text{ \AA}$  (Hg I) and  $\lambda=1942 \text{ \AA}$  (Hg II).  
Orig. Art. has 10 figures including several schematics and block diagrams

ASSOCIATION: Uzhgorods'ky Derzhuniversity\*tet (Uzhgorod State University)

SUBMITTED: 11Jul63

DATE ACQ: 19Mar64

ENCL: 01

SUB CODE: PH, SD

NO REF SOV: 009

OTHER: 002

Card 3/4



*Es. 116.*

Microchemical determination of magnesium. P. Yuhulov (Zavod.  
Lab., 1939, 8, 491--495).—Mg is pptd. as  $Mg(OH)_2$  and the latter  
titrated with 0.1N-HCl. J. J. B.

PROCESSING AND PROPERTIES INDEX		TEST AND ANALYSIS INDEX	
<p>ca</p> <p>Microchemical determination of magnesium. P. Vukobratovic, <i>Zemljopisna Izb.</i> 8, 494-5 (1940).-- The method is based on the vol. of HCl required to dissolve the Mg(OH)<sub>2</sub> ppt. First, ppt. the Mg(OH)<sub>2</sub> with excess 0.1 N NaOH, boil the soln. for 3 min., dil. to 100 ml. with water, filter, and titrate the filtrate with 0.1 N HCl using Congo red indicator to det. approx. NaOH used to ppt. the Mg. To a portion of the test soln. corresponding to 1.1-1.2 ml. of 0.1 N NaOH, add NaOH in excess (0.1-0.2 ml.), 1 ml. dist. water, and 1 drop of Congo red, heat carefully to boiling, keep in boiling water for 3 min., and centrifuge. Neutralize the excess NaOH in the supernatant soln. with 0.1 N HCl, mix the Mg(OH)<sub>2</sub> ppt. with small amts. of 0.1 N HCl until a blue color is produced, heat the soln., keep in boiling water, and add more HCl to dissolve the ppt. completely. Titrate the excess HCl with 0.1 N NaOH. Any free acid or NH<sub>4</sub> salt in the soln. to be tested should be removed by titration to a pH of 3-5.2 and by gentle ignition. Differences between captl. and actual values ranged from 0.00005 to 0.00003 mg./ml. soln.</p> <p>B. Z. Kamich</p>		<p>7</p>	
<p>ASB-55A METALLURGICAL LITERATURE CLASSIFICATION</p>			

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PROCESSING AND PROPERTIES INDEX

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ck

Volumetric determination of reducing sugars by the potassium iodide and sodium thiosulfate method. P. VUKULOV. *Ukrain. Khim. Zhur.* 6, Tech. Wiss. Teil, 171-5 (1932).--To 5 cc. of 10%  $\text{CuSO}_4$  (34.639 g. of crystals in 100 cc. of water) add 15 cc. of a soln. of  $\text{K}_2\text{CO}_3$  +  $\text{KHCO}_3$  (86.2 g.  $\text{K}_2\text{CO}_3$  + 12 g.  $\text{KHCO}_3$  in 200 cc. of water). Then add 2-2.5 cc. of 1%  $\text{C}_6\text{H}_{12}\text{O}_6$  soln. and boil 4 min. When the ppt. of  $\text{Cu}_2\text{O}$  has settled, filter through an asbestos filter and wash with hot water contg. a little  $\text{K}_2\text{CO}_3$  +  $\text{KHCO}_3$ . Dissolve the  $\text{Cu}_2\text{O}$  from the filter with  $\text{Fe}(\text{SO}_4)_3$  soln., transfer the soln. to a glass stoppered flask, neutralize with 10%  $\text{H}_2\text{SO}_4$ , add 5 cc. of 20%  $\text{KI}$  and shake the contents of the flask for 1.5 min. Titrate the liberated  $\text{I}_2$  with  $\text{Na}_2\text{S}_2\text{O}_3$ . V. D. K.

ASB-5LA METALLURGICAL LITERATURE CLASSIFICATION

REGION: 570-03, 570

EXCLUDED MAP ONLY: 001

EXCLUDED: 001

REGION: 570-03, 570

EXCLUDED MAP ONLY: 001

EXCLUDED: 001

VUKUROV, Stanislav; PAVLOVIC, Dejan

Unusual variation of thoraco-abdominal injury. Srpski arh.  
celok. lek. 85 no.3:355-358 Mar 57.

1. I Hirurška klinika Medicinskog fakulteta u Beogradu.  
Upravnik; prof. dr. Bogdan Kosanovic.

(THORAX, wds. & inj.

thoracoabdominal caused by shot wd., surg. (Ser))

(ABDOMEN, wds. & inj.

same)

VUKUROV, Stanislav; SIMIC, Petar

Disinsertion of the long head of the biceps brachii muscle.  
Srpski arh. celok. lek. 85 no.4:476-480 Apr 57.

1. I Hirurška klinika Medicinskog fakulteta u Beogradu.

(Upravnik: prof. dr. Bogdan Kosanovic).

(ARM, musc. & tendons

disinsertion of long head of biceps brachii (Ser))

AUTHORS: Vul', A.A., Eydel'man, L.A., Engineers SOV-117-5E-8-14/28

TITLE: The Cutting of Pipes by Turning Rollers (Rezaniye trub vrashchayushchimisya rolikami)

PERIODICAL: Mashinostroitel', 1958, Nr 8, pp 33-34 (USSR)

ABSTRACT: Turning disc rollers (Figure 1) are used for cutting copper and copper-nickel pipes in order to avoid losses of material. The rollers are made from steel R9, R18, or from the alloyed steel KhVG. The roller is held in a special holder. The pipe is fastened by a pneumatic clamp chuck. The speed of cutting is 160 m/min. The new method increases the productivity 2.5 times. Losses of material have been cut; in every ton of cut pipes, 215 kg of metal are saved. There are 3 diagrams.

1. Cutting tools - Performance
2. Copper pipes - Cutting
3. Copper-nickel pipes - Cutting

Card 1/1

VUL, A.I., starshiy inzh.; BAZYLOV, K.B.

Engineering department of the Karaganda Post Office.  
Vest. svyazi 22 no.1:20 Ja '62. (MIRA 14:12)

1. Pochtovoye upravleniye Ministerstva svyazi Kazakhskoy SSR  
(for Vul). (Karaganda---Postal service)

VUL, A.I.; GUZKO, A.G.

Engineering office of the Alma-Ata post office. Vest. svyazi 21  
no.4:15 Ap '61. (MIRA 14:6)

1. Nachal'nik laboratorii Alma-Atinskogo pochtamta (for Vul).
2. Nachal'nik tekhnicheskogo kabineta Alma-Atinskogo pochtamta  
(for Guzko).

(Alma-Ata--Post service)



PALIY, A.M.; ANTUPOV, P.V.; VUL', A.M.; OVCHAROV, S.M.

Recent data on the gas potential of the ternary sediments of  
the southeastern part of the outer zone of the Carpathian  
piedmont fault. Neft. i gaz. prom. no. 4:6-9 O-D '64  
(MIRA 18:2)

L 02936-67 EWT(d)/EWT(1) EEC(k)-2/T IJP(c) BB/GG

ACC NR: AP6033213

SOURCE CODE: UR/0142/66/009/004/0428/0435

AUTHOR: Vul', V. A.

ORG: none

TITLE: A tunnel diode <sup>166</sup>memory cell for radio-frequency pulses

SOURCE: IVUZ. Radiotekhnika, v. 9, no. 4, 1966, 428-435

TOPIC TAGS: computer memory, computer storage device, tunnel diode

ABSTRACT: A tunnel diode storage cell has been developed in which the two states (ZERO or ONE) are defined by the presence or absence of a high-frequency output

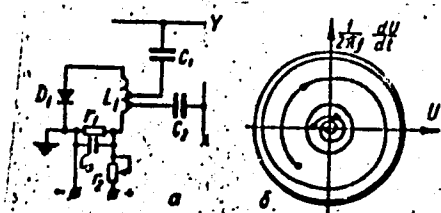


Fig. 1. Tunnel diode memory cell and its phase-space diagram.

Y - Word line, X - bit line.

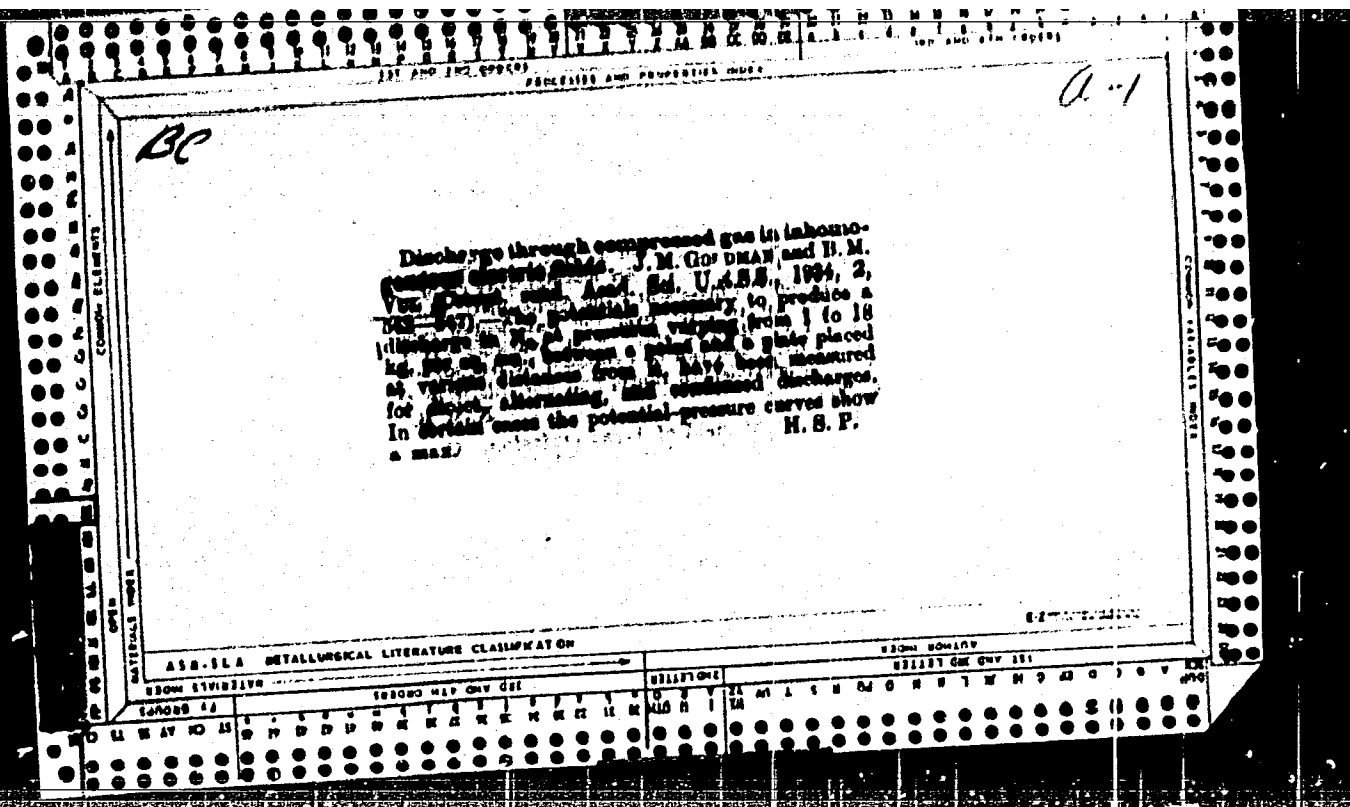
Card 1/2

UDC: 621.374.32:621.382.233

Card 2/2

VUL, B.M.  
CA

Progressive breakdown of solid insulators. In 1911, Phyth 2, Subdivision 2, 27(1032)---The dependence of the breakdown p.d. on the no. of current impacts was studied for a series of solid insulators including glass, oak, salt, mica and cable paper. With glass the decrease in breakdown p.d. with the no. of current impacts is small. With cable paper it is large, and other insulators are intermediate. This decrease is due to the cumulative damage of each impact. The damage can be of chem. or mech. nature. The presence of surface charges as well as the use of a.c. makes progressive breakdown possible at lower voltages. R. I. ROSENKRANTZ



1st and 2nd columns

PROCESSING AND PROPERTIES INDEX

Ca

The electrical breakdown of compressed nitrogen in a non-uniform electric field. I. M. Gaidman and B. N. Tech. Phys. U. S. S. R. 1, 407-408 (in English); J. Tech. Phys. (U. S. S. R.) 4, 1813-21 (1931) (in Russian). When the point electrode is pos. the point-plate breakdown voltage is a max. between 1 and 15 kg./sq. cm., whereas when the point is neg. the voltage increases continuously with pressure. Irradiation by  $\gamma$ -rays widens the range and raises the max. of the breakdown voltage vs. pressure curve. F. H. Rathmann

458-15.4 METALLURGICAL LITERATURE CLASSIFICATION

REGION: SYMBLION

1930-1939

1940-1949

1950-1959

1960-1969

1970-1979

1980-1989

1990-1999

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BC

**Influence of photo-electric current on the breakdown voltage.** B. M. VUL and I. M. GOLDMAN (Compt. rend. Acad. Sci. U.S.S.R., 1935, 1, 363-365).—The breakdown voltage of 20 coloured NaCl crystals has been examined under the influence of d.s. and suddenly improved voltage. One half of the crystal was illuminated, the other half darkened. With suddenly improved voltages no difference was observed between the two halves of the crystal. W. H. A.

ASIA-51A METALLURGICAL LITERATURE CLASSIFICATION

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VUL, B.M.

ca

Breakdown and flash-over of solid dielectrics in compressed nitrogen. B. M. Vul and I. M. Goldman. Bull. acad. sci. U. R. S. S. 1930, 879-88; cf. C. A. 30, 7003. B. C. A.

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

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21

VUL, B.M.  
CA

Breakdown of compressed nitrogen in a nonuniform electric field. II. B. M. Vul and I. M. Goldman. *J. Tech. Phys. (U. S. S. R.)* 6, 244-53 (1935); cf. C. A. 29, 783P.—Data are given for the discharge potential at various temps., pressures and for various shapes of plane-electrodes (plane-sphere, plane-point, plane-wedge, plane-cylinder). Within small limits an increase of temp. increases the breakdown potential. With increasing pressure the breakdown potential at first increases almost linearly, then less so and finally passes through a max. In very nonhomogeneous fields the presence of a barrier greatly increases the breakdown potential. P. H. R.

ASH-SLA DETAILLUGICAL LITERATURE CLASSIFICATION

FROM STRONG

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[illegible]

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CA

Coremic high-frequency condensers. B. M. Vul'pud  
G. I. Skanavi. *Bull. acad. sci. U.R.S.S., Ser. phys.* 8,  
191-9(1944).-- Ceramic elec. condensers are of 2 kinds:  
compensating and stable. The first have a neg. temp.  
coeff. (TK) of the dielec. const., which compensates the  
temp. coeff. of expansion; the second have TK approach-  
ing zero. Rutile, having a high dielec. const. and a large  
neg. TK, is used as the basic material for the manuf. of  
compensating condensers. For stable condensers, manes  
having both pos. and neg. TK were investigated. Mg  
titanate has a low, pos. TK and a comparatively small  
dielec. const. Increasing the content of rutile in the  
compn. to 45% increases the dielec. const. to 13. Compos.  
of  $\text{TiO}_2$  and dolomite can be prep'd. that have a dielec.  
const. of approx. 80 and neg. TK of the order of  $10^{-4}$ .  
By combining compos. of  $\text{TiO}_2$  with  $\text{MgO}$  and with dolo-  
mite manes of any desired TK value can be obtained.  
The TK of the mixt. is the arithmetical mean of those of  
its components. Four references. W. R. Henn

ASM-56A METALLURGICAL LITERATURE CLASSIFICATION

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3518-3519

VUL, B. M.

"Dielectric Permeability of Titanium Metals of Group II," a report submitted at General Assemblies of OFMN in 1944.

IAN-Ser Fiz., Vol 2, No 3, 1945

METALLURGICAL LITERATURE CLASSIFICATION																									
SECTION ONE													SECTION TWO												
SUBSECTION ONE													SUBSECTION TWO												
<p>Dielectric permeability of rutile mixtures. B. M. Vol. Doklady Akad. Nauk S. S. S. R. 43, 398-10; <i>Comp. rend. acad. sci. U. R. S. S. 43, 292-1</i> (1941) (in English).—Dolomite and MgO combine chemically with <math>TiO_2</math> to form compds. having, resp., neg. and pos. temp. coeffs. of dielec. permeability. By proper combination of these two different compds. the temp. coeff. can be made zero—an important aid in making elec. condensers for use in oscillating circuits whose frequency is to be invariable with temp.</p> <p style="text-align: right;">J. W. Petty</p>																									

19

CA

Ceramic Insulators. B. M. Vul and I. M. Gold'man.  
U.S.S.R. 66,065, March 31, 1945. An insulator for high  
frequency is made by heating at 1400-1500° a mixt. of  
TiO<sub>2</sub> and BaO or SrO taken in the ratio of their mol. wts.  
M. Husek

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

VUL, B. M. (Cor Mor.)

"High-Frequency Ceramic Condensers," a report submitted at the General Assemblies of OPM in 1944

IAN-Ser Fiz, Vol 9, No 3, 1945

PROCESSING AND PROPERTY INDEX																									
1ST AND 2ND CATEGORIES													3RD AND 4TH CATEGORIES												
<p>Dependence of the dielectric constant of barium titanate upon pressure. D. M. Vul and L. F. Vereshchagin (P. N. Lebedev Inst. Physics and Inst. Org. Chem., Acad. Sciences U.S.S.R.). <i>Compt. rend. acad. sci. U.S.S.R.</i>, 48, 634-6(1945)(English summary).-- The capacity of a condenser with barium titanate as dielec. was measured over the pressure range of 0 to 2000 atm. The mean relative change in capacity in this range is <math>\frac{1}{C} \frac{\Delta C}{\Delta p} = 1.2 \times 10^{-6}</math> sq. cm./kg. where C is capacity in cm. and p's pressure in kg./sq. cm. Barium titanate has a dielec. hysteresis, which in addn. to previous data proves that this substance is seignettelec. W. J. Kirkpatrick</p>																									
<p>ASAC-34 METALLURGICAL LITERATURE CLASSIFICATION</p>																									

CA

PROCESSES AND PROPERTIES INDEX

Dielectric constant of barium titanate as a function of strength of an alternating field. B. M. Vul and I. M. Goldman (P. N. Lebedev Inst. of Physics, Acad. Sci. U.S.S.R.). *Compt. rend. acad. sci. U.R.S.S.* 49, 177-80(1945)(English summary).—The dielec. const. ( $\epsilon$ ) of barium titanate at room temp. increases from about 1800 to 8400 as the field strength is increased to 7 kv./cm., the measurements being at a frequency of 50 cycles. At  $-180^\circ$ ,  $\epsilon$  has an initial value of about 200 and rises to 6200 at a field strength of 10 kv./cm. At high frequencies,  $\epsilon$  for barium titanate has a distinct max. at  $80^\circ$  and above this temp.  $\epsilon$  no longer depends on the applied voltage. An abrupt variation in  $\epsilon$  was found at  $125^\circ$ . Cf. CA 40, 1075. W. J. Kirkpatrick

ASR-SLP METALLURGICAL LITERATURE CLASSIFICATION

REGIONAL BUREAU



CA 2

Dielectric constants of some titanates. By M. V. V. (Lebedev Phys. Inst., Acad. Sci. U.S.S.R., Moscow) Nature 156, 440(1945). Dielectric constants were detd. at room temp. and at 1 M for several titanates: Be 70, Mg 17, Ca 116, Zn 34, Cd 82, Ba > 1000. The dielectric const. of Ba titanate is shown from -100° to +200°; there is a flat peak (in the capacity) at 15°, and a sharp peak at 140°.

G. M. Petty

ASM-51A METALLURGICAL LITERATURE CLASSIFICATION

GROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Processes and Properties Index

2

Materials with high dielectric constants. B. M. Volin, *J. Phys. (U.S.S.R.)* 10, 95-100 (1946); cf. C.A. 40, 4290. — The dielec. consts. of the titanates of Be, Ca, Sr, Ba, Mg, Zn, Cd were investigated during a search for insulators with high dielec. const. Ba titanate was found to have a much higher dielec. const., at least 1000. The dependence of  $\epsilon$  on the temp. was investigated and was found to reach a max. of about 6800 at 60°. Ba titanate is a new type of ferroelectric. The dependence of the dielec. const. on the temp. and the energizing field is discussed from a theoretical standpoint. S. E. Whitcomb

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

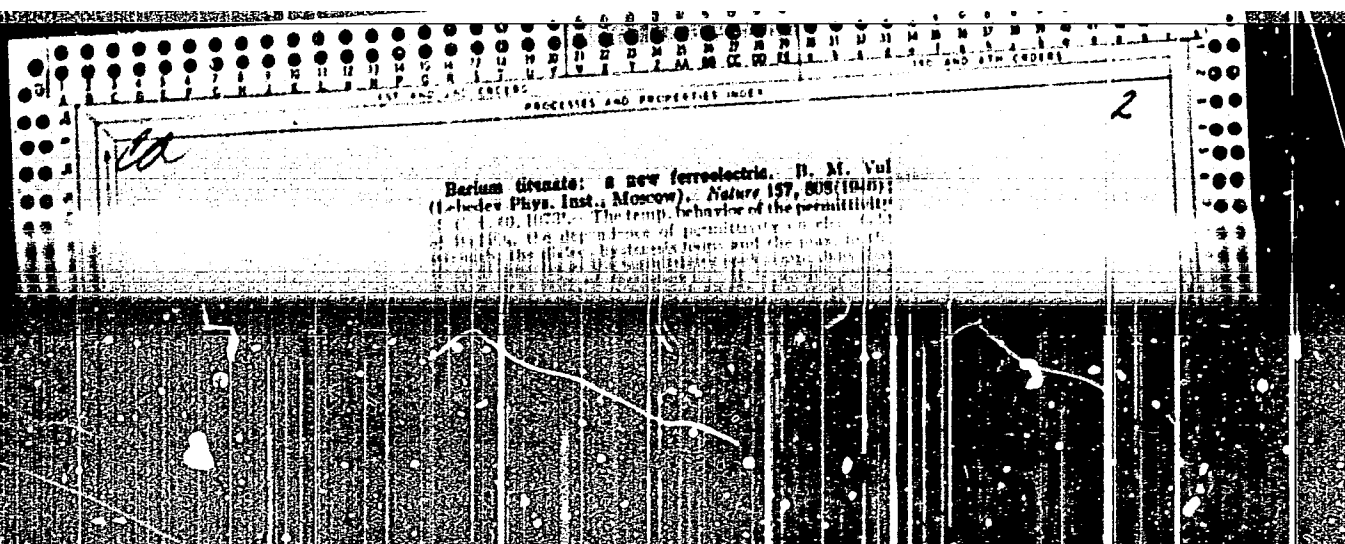
SEARCH SYMBOLS

PROPERTY SYMBOLS

SEARCH ONE ONLY

PROPERTY ONE ONLY

PROCESSING AND PROPERTY INDEX																									
<p>Dielectric hysteresis in barium titanate. H. M. Vul- and I. M. Goldman. <i>Compt. rend. acad. sci. U.S.S.R.</i> 51, 21-3(1960); cf. <i>C.A.</i> 40, 45759. - Measurements made with a cathode-ray oscillograph revealed dielec. hysteresis in Ba titanate. Hysteresis is absent at a temp. over 80°. This indicates structural changes in the Ba titanate crystal on heating. Data on the dielec. properties, sp. heat, and x-ray data indicate that Ba titanate belongs in a class with ferroelectrics. A plot of the capacitance of a Ba ti- tanate condenser vs. applied voltage is included. Ray- leigh's coeff. is 0.35 cm./V<sup>max</sup>. Ray E. Heik.</p>																									
<p>ASAC-11.4 METALLURGICAL LITERATURE CLASSIFICATION</p>																									
<p>RESEARCH AND DEVELOPMENT</p>																									
<p>RESEARCH AND DEVELOPMENT</p>																									



PROCESSING AND REPRODUCTION INDEX

3

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A new form of barium titanate. B. M. Vul and I. M. Gol'dman (P. N. Lebedev Phys. Inst. Acad. Sci. U.S.S.R., Moscow). *Doklady Akad. Nauk S.S.S.R.* 60, 41-3 (1948). --BaTiO<sub>3</sub> prepd. from chemically pure BaCO<sub>3</sub> and TiO<sub>2</sub> (I) showed no piezoelectric properties (dielec. const.  $\epsilon \sim 50$ , little dependent on the temp.), in contrast to the compl. made from tech. materials (II) (e.g. from BaCO<sub>3</sub> contg. 0.45% CaCO<sub>3</sub>). X-ray examn. showed I and II to be structurally different, II having a tetragonal lattice with  $a = 3.98$ ,  $c = 4.04$  Å., I a lattice close to rhombohedral,  $a = b = c = 4.04$  Å., angle close to 90°. A sample of I, with  $\epsilon 65$ , was found to have a distorted cubic lattice; a sample of I with 1% SrCO<sub>3</sub> added (III), showed the usual BaTiO<sub>3</sub> lattice and had  $\epsilon 1035$ . Both I and III were found to contain some rutile. Evidently, in I, Ti ions are deprived of the freedom of displacements within the O<sub>4</sub> octahedrons. Piezoelectric. BaTiO<sub>3</sub> is easily obtained from I by adding to it about 2% Al<sub>2</sub>O<sub>3</sub>; such samples had a tetragonal lattice with  $a = 3.98 \pm 0.01$  and  $c = 4.02 \pm 0.01$  Å. N. Thon

METALLURGICAL LITERATURE CLASSIFICATION

SOURCE SYMBOL

SYMBOL ONE ONLY

VUL, B.M.

Present-day state of the physics of dielectrics. Elektrichestvo  
no.1:3-12 Ja '49. (MLA 7:10)

1. Fizicheskiy institut im. Lebedeva Akademii nauk SSSR. 2. Chlen-  
korrespondent Akademii nauk SSSR.  
(Dielectrics)

PA 160T98

VUL, B. M.

USSR/Physics - Titanates  
Dielectrics

May 50

"Electrical Strength (KV/CM) of Titanates of Metals  
in the Second Group of the Periodic Table," B. M.  
Vul, I. M. Gol'dman, R. Ya. Razbash, Phys Inst imeni  
Lebedev, Acad Sci USSR, 6 pp

"Zhur Eksp 1 Teoret Fiz" Vol XX, No 5

Establishes that electrical strengths 175 to 65 kv/cm,  
respectively, of titanates of Be, Mg, Ca, Zn, Sr, Cd,  
Ba are relatively small and depend only slightly on  
composition. Measurements on BaTiO<sub>3</sub>, lowest in elec-  
trical strength, show that significant variations in  
dielectric permeability do not influence its electri-  
cal strength. Submitted 31 Dec 49.

160T98

VUL, B.M.

2

The nature of the piezoelectric properties of barium titanate. B. M. Vul, *Pamyati Sergeya Iosadetskogo*, *Uchenye Zapiski Kazansk. Univ.* 1952, 319-23. The piezoelectric properties of  $\text{BaTiO}_3$  can be explained on the basis of the interrelation between deformation and polarization taking place in this material below the Curie point. Mech. action changes the existing deformation and simultaneously the polarization, which manifests itself as direct piezoeffect in the form of free elec. charges on the electrodes of the piezoelement. Elec. action changes the magnitude of the acquired polarization and the deformation of the elementary cells in the crystallographic lattice, which manifests itself as reverse piezoeffect, i.e. as variation of the dimensions of the whole piezoelement. On the basis of these assumptions formulas are developed for the calcn. of the piezocoeffs. Piezocoeffs. were calcd. for monocrystals at temps. where  $\text{BaTiO}_3$  still retained tetragonal structure. These calcd. piezocoeffs. corresponded to the exptl. values found by statistical measurements on polarized polycryst. samples.  
N. Goldowski



VUL', V. M.

USSR/Electronics - Piezoelectricity

Apr 53

"Application of Piezoelectric Devices," A. Flonskiy

"Radio, No 4, pp 23-25

General account of the use of piezoelectric devices as ultrasonic radiators, as transducers for the measurement of pressure, acceleration, and vibrations, as the sensitive element in quartz clocks, etc. A. V. Shubnikov, V. M. Vul', and V. P. Konstantinova are credited with developing a theory of piezoelectricity.

PA 255T91

VUL, B. M.

USSR/Physics

Card 1/1

Author : Vul, B. M., Memb. Corresp. of AN SSSR

Title : Capacity of transitory layers in semi-conductors

Periodical : Dokl. AN SSSR, 96, Ed. 2., 257 - 259, May 1954

Abstract : A transitory layer between parts of a semi-conductor having different degree of conductivity expands to the boundaries of space charges where the intensity of the electrical field can be considered zero. The boundaries of space charges may vary under the effect of the intensity applied from without. The differential capacity can easily be measured thus enabling to determine the thickness of the transitory layer in relation to the constant intensity applied from without. Three references; 1 USSR 1953.

Institution : The P. N. Lebedev Physics Institute at the Acad. of Sc. USSR.

Submitted : March 6, 1954

Vol. B.M.

AID P - 3031

Subject : USSR/Electricity  
Card 1/1 Pub. 27 - 18/33  
Author : Vul, B. M., Corr. Memb., Academy of Sciences, USSR  
Title : Physical grounds for the technical utilization of  
semiconductors  
Periodical : Elektrichestvo, 7, 102-107, J1 1955  
Abstract : The author briefly reports on the principles of  
operation of semiconductor rectifiers (diodes),  
amplifiers (triodes), and also of thermo- and photo-  
elements. He enumerates their advantages and possible  
applications. Two diagrams, 8 references (1953-1955)  
(6 Soviet).  
Institution : None  
Submitted : My 18, 1955

Vul, B.M.  
USSR/Physics - Semiconductors

FD-2397

Card 1/1 Pub. 153-1/21

Author : Vul, B. M.

Title : Dielectric properties of the transitional layers in semiconductors

Periodical : Zhur. tekhn. fiz. 25, 3-10, Jan 1955

Abstract : Transitional layers are created in semiconductors in connection with sharp changes in the concentration of the admixtures (impurities) serving as sources of electrons or as their sinks (i.e. as donors or acceptors). The role of transitional layers between two semiconductors with different types of conductivities was theoretically treated for the first time by B. I. Davydov (ibid. 8, 1938), and experimentally investigated by A. V. Ioffe (ibid. 18, 1948); a detailed survey of the modern theory of solid rectifiers and contact semiconductors was given by A. I. Gubanov (ibid. 23, 1953). In most works the principal task has been the clarification of the process of rectification and therefore the effects of the joint action in the transitional layer of diffusion and electrical conductivity have been considered. In the present work the author considers the capacity, resistance, and dielectric losses of the transitional layer under the condition where the contact difference of potentials is much larger than  $kT/q$  ( $q$ : electron charge). 9 ref.

Institution: --

Submitted : April 30, 1954

PHASE 1 BOOK EXPLOITATION 947

Vul, B.M., Corresponding Member, USSR Academy of Sciences

Segnetoelektrichestvo (Seignettelectricity) Moscow, Izd-vo AN SSSR, 1956. 27 p. (Series: Akademiya nauk SSSR. Nauchno-populyarnaya seriya) 7,000 copies printed.

Resp. Ed.: Vonsovskiy, S.V., Corresponding Member, USSR Academy of Sciences; Ed. of Publishing House: Dreyer, O.K.; Tech. Ed.: Makuni, Ye. V.

PURPOSE: The book may be useful to persons working with ferroelectric materials.

COVERAGE: A discussion of ferroelectric (seignettelectric) materials is presented. Attention is given to a description of Calcium titanate and the application of ferroelectric materials in the construction of electrical devices. No personalities are mentioned. There are 14 references, of which 10 are Soviet and 4 English.

Card 1/3

947

Seignettoelectricity

TABLE OF CONTENTS:

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Induced electric polarization

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b. Dielectric permeability

Barium titanate

c. Dielectric hysteresis

d. Piezoeffect

e. Structural features and ferroelectric properties

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a. Miniature capacitors

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b. Nonlinear capacitors

26

c. Piezoelements

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d. Computer storage mechanisms - "electric memory"

29

Bibliography

AVAILABLE: Library of Congress (TK 453 .v8)

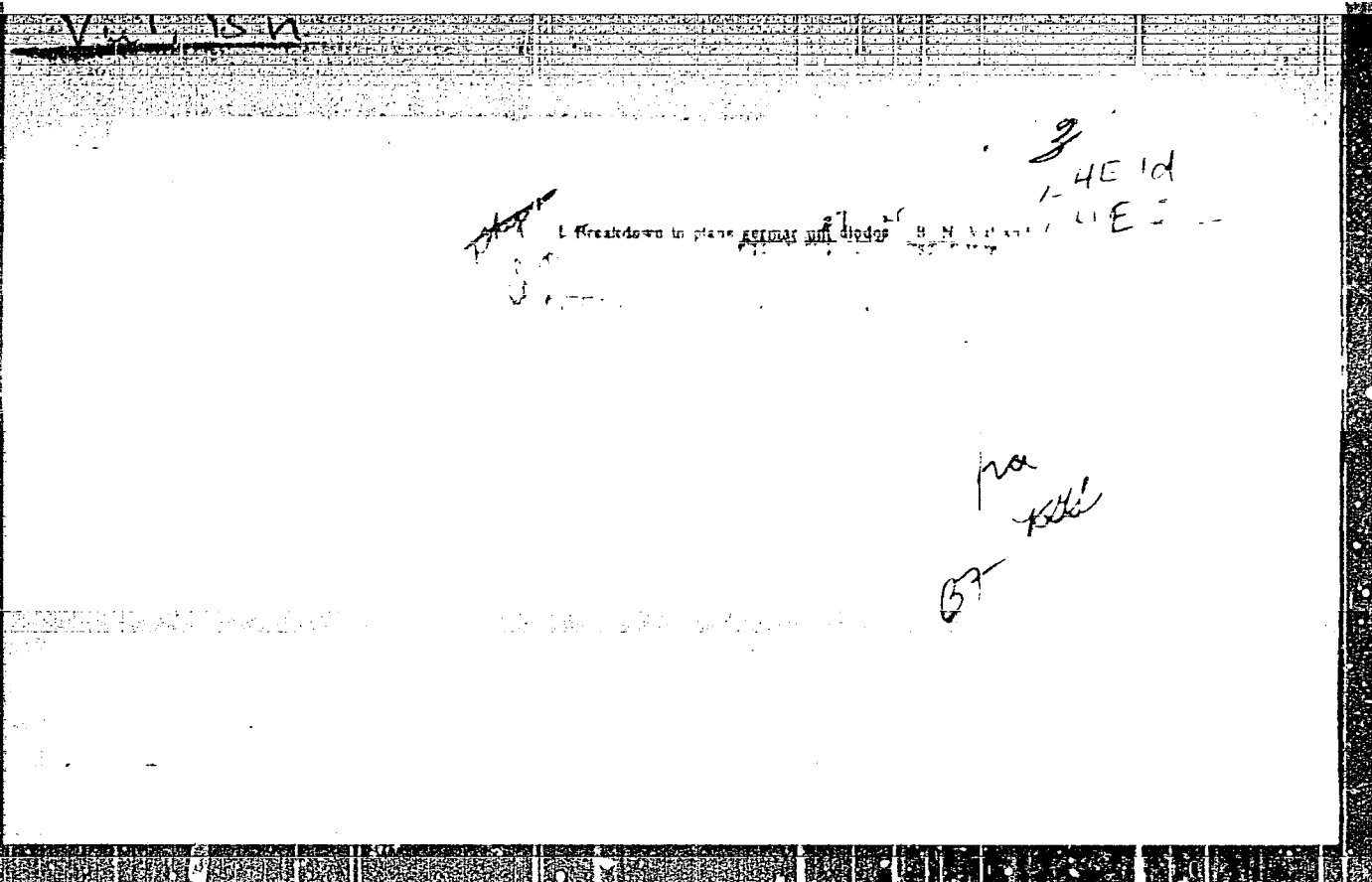
JP/nah  
12-10-58

Card 3/3

VUL B.M.  
Basis of theory and stems results of the investigation of  
germanium diodes and triodes, B. M. Vut (P. N. Le) ader

Investigation of the properties of germanium diodes and triodes  
was carried out in the laboratory of the Institute of Physics of the  
Academy of Sciences of the USSR. The results of the investigation  
are presented in the form of a series of graphs and tables. The  
graphs show the dependence of the current on the voltage for  
different values of the parameters of the diodes and triodes.  
The tables give the values of the parameters of the diodes and  
triodes for different values of the current and voltage.





VUL, B. M.  
Category : CHINA/Electricity - Semiconductors

G-3

Abs Jour : Ref Zhur - Fizika, No 1, 1957 No 1554

Author : Vul, B. M., Khuan Kun', Van, Shou-u

Title : Physical Fundamentals and Technical Use of Semiconductors

Orig Pub : Kesyé tunbao, 1956, No 6, 20-28

Abstract : No abstract

Card : 1/1

VUL, B.M.

Crystals with a great future. Tekh.mol. 24 no.5:7-11 My '56.  
(MIRA 9:8)

1. Chlen-korrespondent Akademii nauk SSSR.  
(Semiconductors)

Vul, B.M.

Category : USSR/Electricity - Dielectrics

G-2

Abs Jour : Ref Zhur - Fizika, No 2, 1957, No 4147

Author : Bagdanov, S.V., Vul, B.M., Razbash, R.Ya.

Title : Influence of Polarization Conditions on the Piezo Properties of Barium Titanate

Orig Pub : Zh. tekhn. fiziki, 1956, 26, No 5, 958-962

Abstract : The effect of the intensity of the polarizing electric field  $E$  and of the temperature  $T$  on the piezo-modulus  $d_{33}$  of ceramic  $\text{BaTiO}_3$  was investigated. It is shown, that the polarization of thick specimens can be produced at lower values of  $E$  and at higher values of  $T$ . The closer the polarization temperature is to the Curie temperature, the less the value of  $E$  required for the polarization.

To orient the fundamental part of the domains in the interval of the rapid growth of the spontaneous polarization ( $6 - 7^\circ$  below the Curie point),  $E$  must not be less than 5 kv/cm for any values of  $T$  of the polarization.

Card : 1/1

SUBJECT USSR / PHYSICS  
 AUTHOR VUL, B.M.  
 TITLE On the Breakdown of Transition Layers in Semiconductors.  
 PERIODICAL Zhurn.techn.fis, 26, fasc.11, 2403-2416 (1956)  
 Issued: 12 / 1956

CARD 1 / 2

PA - 1678

The principal forms of breakdown in electron-hole-transitions. The disruptive voltage of germanium diodes at increased temperatures diminishes considerably with increasing temperature. Therefore thermal ionization plays the most important part among the processes which promote breakdown. However, in the case of diodes of low resistance germanium, the disruptive voltages depend in a wide range of temperature only little on temperature and increase with rising temperature. With these electrodes the increase of the number of electrons mainly takes place in form of collision ionization. Thus it is possible to distinguish between a thermal and a dielectric form of breakdown both in the case of semiconductors and in that of dielectrics. The diodes of germanium with an increased specific resistance (order of magnitude 10 ohm.cm) have a smaller disruptive voltage for parallel current than for current pulses. By improving heat transfer it is possible to increase disruptive voltage. However, the dependence of disruptive voltages on temperature and on the conditions of heat transfer is not so marked in the case of these diodes as in the case of purely thermal breakdown. It may be that breakdown is brought about by the simultaneous effect of thermal- and collision ionization ("thermoelectric breakdown").

Zurn.techn.fiz,26,fasc.11, 2403-2416 (1956) CARD 2 / 2

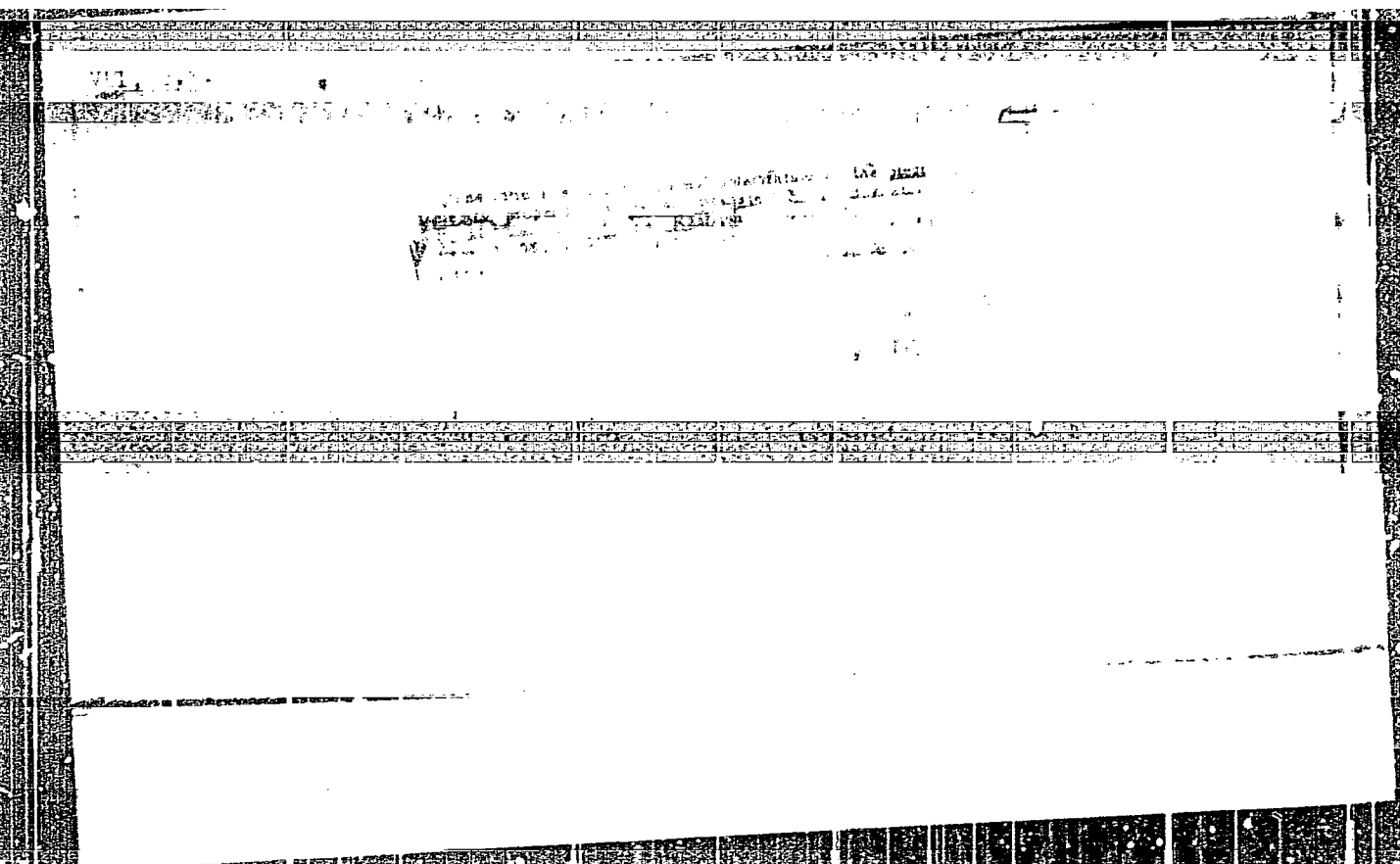
PA - 1678

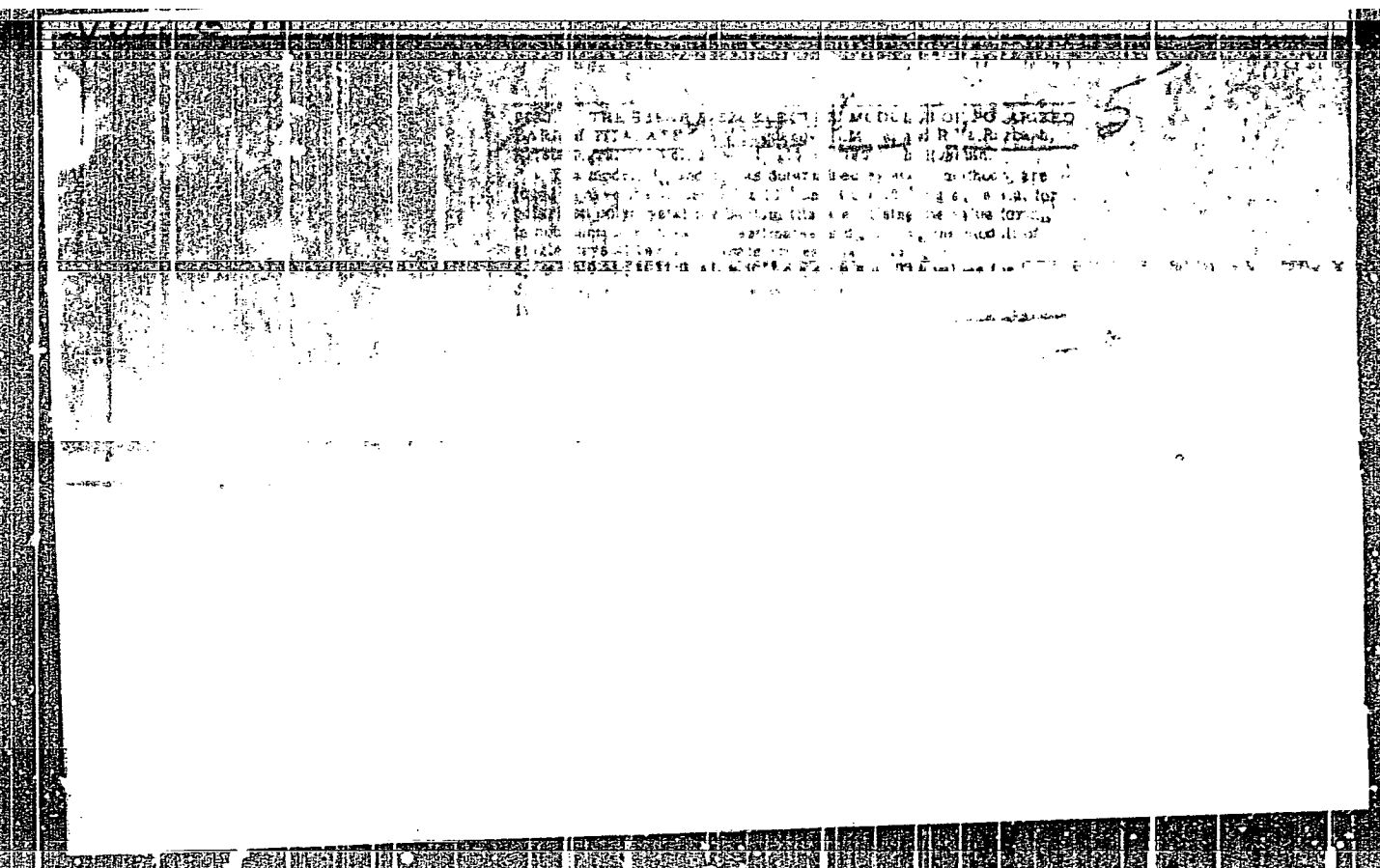
Thermal breakdown: At first the bases of the elementary theory are recalled to memory after which they are augmented by taking the following additional factors into account: Influence exercised by the resistance R which is independent of temperature; influence of additional amperage which is independent of voltage; influence of additional losses which are independent of counter-voltage; influence exercised by the heat conductivity of the crystal.

Electric breakdown: was found to occur in pure form in the case of parallel voltage only with diodes of low-resistance germanium, but in the case of pulse-like tests it was found in germanium of any resistance. Electric breakdown is caused on the occasion of electron-hole transitions as well as in gases by collision ionization. The computation of the conditions of breakdown is sketched out.

Thermoelectric breakdown: Already before thermal breakdown is about to occur it is possible that the amperage increases considerably because of ionization if field strengths in the electron-hole-transition are high. This increases heating of the diode and thus also thermal ionization in it. The electrons liberated by thermal ionization participate in collision ionization, and, if intensity is sufficient, the common effect exercised by thermal- and collision ionization may lead to the destruction of the state of equilibrium, and so breakdown.

INSTITUTION: Moscow Physical Institute of the Academy of Science.







AUTHOR

VUL, B.M., VAVILOV, Y.S., SMIRNOV, L.S.,  
GALKIN, G.N., PATSKEVICH, V.M.,  
SPITSYN, A.V.

39-6-7/24

TITLE

On the transformation of the energy of  $\beta$ -particles into electric energy in germanium crystals with P-N transitions. (O preobrazovanii energii  $\beta$ -chastits v elektroenergiyu v kristallakh germaniya s P-N-perekhodom. - Russian) Atomnaya Energiya 1957, Vol 2, Nr 6, pp 533-537 (USSR).

PERIODICAL

ABSTRACT

In 1955 the authors carried out experiments in the determination of the degree of efficiency of the transformation mentioned in the title. The P-N transitions were obtained by the melting of indium.  $Sr^{90}$  -  $Y^{90}$  preparations served as sources of  $\beta$ -particles. The total activity of the primary radioactive preparations amounted to 50, 100, and 200 millicuries. As source of  $\beta$ -particles strontium sulphate tablets with 50 and 100 millicurie and strontium carbonate tablets with 200 millicurie were used. A diagram shows the  $\beta$ -spectra of these sources. Also measurements during irradiation of a semiconductor with artificially accelerated electrons (400 to 1150 keV) were carried out. The degree of efficiency

CARD 1/3

CARD 2/3

89-6-7/24

On the transformation of the energy of  $\beta$ -particles into electric energy in germanium crystals with P-N transitions.

the degree of efficiency of the transformer diminishes. Further details are mentioned.  
(With 8 Illustrations)

ASSOCIATION: not given.  
PRESENTED BY: -  
SUBMITTED: 18.1. 1957.  
AVAILABLE: Library of Congress.

CARD 3/3

USSR/Electricity - Dielectrics

G-2

Abs Jour : Ref Zhur - Fizika, No 1, 1958, 1290

Author : Degunov, S.V., vul. B.M., Simonin, A.M. APPROVED FOR RELEASE: 09/01/2001 CIA-RDP86-00513R001961310002-8"

Inst : Physics Institute, Academy of Sciences, USSR, Moscow

Title : Connection Between the Dielectric, Piezoelectric, and Elastic Properties of Polycrystalline Ceramics and Monocrystals.

Orig Pub : Izv. AN SSSR, ser. fiz., 1957, 21, No 3, 374-378

Abstract : A general method is proposed for calculating the tensors of the dielectric constant, the piezomoduli, and the elastic constants of polycrystalline materials from corresponding characteristics of the initial monocrystals, a method based on averaging the equations of the piezoelectric converter, which is a generalization of the work by B.M. Vul (Vestn. informatsii BNT MV, 1951, 3, 15), M.Ya.

Card 1/3

constant of the ceramic form are calculated in general.

USSR/Electricity - Dielectrics

G-2

Abs Jour : Ref Zhur - Fizika, No 1, 1958, 1290

constants, while at  $\theta = 55^\circ$  such anisotropy should be experimentally observed. By comparison with experimental results, the authors conclude that the change in the direction of the polar axis of the single crystals upon polarization is essentially at an angle of  $180^\circ$ .

Card 3/3

*Vol. B. M.*  
USSR/Electricity - Dielectrics

G-2

Abs Jour : Ref Zhur - Fizika, No 1, 1958, 1277

Author : Vul, B.M.

Inst : Physics Institute, Academy of Sciences, USSR

Title : Nonlinear Properties of Ferroelectrics.

Orig Pub : Izv. AN SSSR, ser. fiz., 1957, 21, No 3, 379-381

Abstract : The nonlinear properties of ferro-ceramics above the Curie point can be characterized quantitatively by the value of the coefficient ( $\beta$ ) of  $P^3$ , which represents the field intensity  $E$  in the form of a power series in the polarization  $P$ . The value of this coefficient can be obtained from measuring the equivalent or reversible dielectric constant ( $\epsilon$ ). Changes of the equivalent were made with a Schering bridge at 50 cycles for different temperatures. They have shown that  $\beta$  depends

Card 1/2

Card 2/2

SUBJECT

USSR / PHYSICS

CARD 1 / 2

PA - 1944

AUTHOR

VUL, B.M., SOTOV, A.P.

TITLE

The Surface Discharges on Electron-Hole Transitions.

PERIODICAL

Zhurn. tekh. fis. 27, fasc. 1, 211-212 (1957)

Issued: 2 / 1957

On the boundary of the electron-hole transition on the surface of the semiconductor breakdown is complicated by a boundary effect. The surrounding medium is able to limit breakdown voltage considerably if on the surface of the diode "overlapping" (i.e. a surface discharge at a voltage that is lower than the breakdown voltage of the electron-hole transition in the interior of the semiconductor) occurs. In the case of constructions encountered in practice the electron-hole transition is located in a gaseous medium at atmospheric - or lower - pressure. For gaseous media there exists a minimum breakdown voltage below which no electric breakdown can occur in this gas. For air the minimum breakdown voltage amounts to  $U_{\min} = 330$  V and to this belongs also the value  $pd \sim 6$ . Here  $p$  denotes the pressure in mm<sup>torr</sup> and  $d$  - the distance between the electrodes in mm. In the case of diodes in which the breakdown voltage of the electron-hole transition in the interior of the sample is less than  $U_{\min}$ , overlapping can therefore not occur at all gas pressures. On the other hand, overlapping can prevent total utilization of the possibilities of the diode in the case of diodes in which the breakdown voltage of the electron-hole transition is more than  $U_{\min}$ .

Zurn.techn.fis.27,fasc.1,211-212 (1957)

CARD 2 / 2

PA - 1944

The measurements carried out by the authors showed that what has just been said is true. In the case of diodes with a breakdown voltage of less than 300 - 400 MeV this breakdown voltage remains constant at any air pressure. Measurements were carried out on diodes which were not mounted in cartridges, and also in such diodes into the cartridges of which holes had been bored.

In diodes with an average breakdown voltage of 400 MeV at normal pressure a surface discharge occurs at diminished air pressure approximately at those values of  $p_d$  which correspond to the voltage  $U_{min}$ . In the case of a further decrease

of air pressure the surface discharges cease. Frequently the properties of the diode are deteriorated considerably by the surface discharges. On the occasion of the practical construction of high-voltage diodes it is obviously necessary, when selecting the medium surrounding the electron-hole transition, to take care that overlapping voltage is greater than the breakdown voltage of the electron-hole transition in the interior of the semiconductor.

The above is a translation of this short report.

INSTITUTION: Physical Institute "P.N.LEBEDEV" of the Academy of Science in the USSR

V. L. B. M.

57-10-1/33

AUTHORS: Vul, B. M., and Shotov, A. P.

TITLE: On the Edge Breakdown of p-n Junctions in Germanium (O krayevom proboye p-n-perekhodov v germanii).

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 10, pp. 2189-2194 (USSR).

ABSTRACT: The breakdown potentials of diffusion junctions (transition) and melted-in  $p^+n^-$  and  $n^+p^-$  junctions were measured in air and in media with an increased dielectric constant. It is shown, that the dielectric constant has a marked influence on the breakdown potentials of the  $p^+n^-$  junctions and that it plays an important rôle in the breakdown of the  $p^+n^-$  and of the diffusion junctions. The observed phenomena can be explained with the assumption, that the surface of the germanium carries a positive charge and that the medium determines the effectiveness of the surface charge. There are 5 figures, 1 table and 3 Slavic references.

ASSOCIATION: Physical Institute imeni P. N. Lebedev AN of the USSR, Moscow (Fizicheskiy institut imeni P. N. Lebedeva AN SSSR, Moskva).

VUL, B. M.,

"Multiplication of Electrons and Holes in p-n Junctions,"  
paper submitted at the International Conference on Solid State Physics  
in Electronics and Telecommunications - Brussels, Belgium, 2-7 June 1958.

Physical Institute of the Academy of Sciences, Moscow.



Vu, B. M.

SI(0), 21 (10)

ARTICLE:

Kurchatov, I. V., Semenov, E. N.,  
Teplov, A. V., Alexandrov, A. P., Ioffe, A. P.,  
Pek, V. A., all of them Institute of Atomic Energy,  
Moscow, Academy of Sciences, USSR

507/50-54-12-2/96

TITLE:

Outstanding Scientific Discovery (Vydaushchaya nauchnaya  
obryt) The Award of the Nobel Prize for Physics to the  
Soviet Scientists P. A. Cherenkov, I. E. Tamm, I. N. Frank  
(It prescribes the Nobel Prize for Physics to the  
Soviet Scientists P. A. Cherenkov, I. E. Tamm, I. N. Frank)

PERIODICAL:

Vestnik Akademii nauk SSSR, 1958, Nr 12, pp 7-9 (USSR)

ABSTRACT:

The Cherenkov radiation named after its discoverer (1934)  
was discovered in investigating the luminescence of pure  
liquids under the influence of radium gamma-rays. The late  
Academician G. I. Vavilov suggested and supervised the  
research work. In 1937 I. E. Tamm and I. N. Frank elaborated  
the theory of this phenomenon, which showed that electrons move  
to be regarded as source of luminescence, these electrons moving  
steadily at a higher velocity than that of light. Observing  
the Cherenkov radiation has become a convenient method of  
measuring the velocity and direction of the flight of fast

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Outstanding Scientific Discovery. The Award of the Nobel Prize for Physics to the Soviet Scientists P. A. Cherenkov,  
I. E. Tamm, I. N. Frank

particles. The Cherenkov counter serves for the registration  
of the charged particles. In 1955 it played an essential part  
in the discovery and investigation of the new elementary  
particles, the antiprotons. The discovery of this phenomenon  
in the Physico-Mathematical Institute and USSR (Institute  
of Physics of the Academy of Sciences, USSR) and its  
theoretical interpretation have in the request of a Soviet  
Academician G. I. Vavilov, P. A. Cherenkov, I. E. Tamm,  
and I. N. Frank were awarded the first class Stalin Prize. The  
Nobel Prize award for Physics in 1958 is considered to be an  
acknowledgment of the great importance of the discovery  
made by Soviet scientists, whereas the award of the Nobel  
Prize for literature to Pasternak is considered to be due to

Card 2/3

AUTHORS: Vul, B. M., Sagal, B. I.

57-28-4 1/39

TITLE: On the Theory of Electron-Hole Transitions in Semiconductors  
(K teorii elektronno-dyrochnykh perekhodov v poluprovodnikakh)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958. Vol. 28, Nr 4, pp. 681-689  
(USSR)

ABSTRACT: Reference is made here to the formula  $\frac{d^2u}{dx^2} - \text{sh } u = -f(x)$  (1.1) by W. Shockley (Ref. 1). This approximate equation is here investigated under the following assumption: Instead of the boundary case studied by Shockley, where the space charge is only produced at the expense of ionized admixtures, it is assumed here that  $\text{sh } u = u$ , i.e. that the equation (1.1) is investigated in the form of

$$(1.4) \dots \frac{d^2u}{dx^2} - u = -f(x)$$

with maintenance of the boundary condition (1.3), that is to say, that  $u$  in the case of  $x = \pm\infty$  is limited. The solution of (1.4) with the condition (1.3) in the form of (4.3) is derived. Now it is determined under which conditions the solution (4.3) can approximately replace the exact solution (1.1) under the

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On the Theory of Electron-Hole Transitions in Semiconductors 57-20-41/30

condition (1.3). It is shown that this is the case in the entire domain of  $-\infty < x < \infty$  when  $A$  (a nondimensional positive constant) is sufficiently small. On that occasion (a dimensionless positive constant) can be of any arbitrary value. In the case of a small excess concentration of the admixtures the potential quantity remains small also in the case of any  $x$ -value. Therefore  $\frac{\partial \psi}{\partial x} \ll 1$ , and equation (1.4) is everywhere a good approximation for equation (1.1). In the modern semiconductor devices  $A \gg 1$ . Therefore other conditions for the usefulness of the linear approximation which hold in the limited inter spaces also when  $A \gg 1$  are examined for the domain  $-\alpha < x < \alpha$  (6.1) and  $-\alpha < x < -\alpha$  (7.1). The equations (6.7) for the first and (7.7) for the second case are obtained. From these follows that they - (6.7) or (7.7) - according as  $m \ll 1$  or  $m \gg 1$  serve as criterion for the usefulness of the linear approximation (4.3) instead of the exact solution (1.1) with the limiting conditions (1.3) in the domain of  $-\alpha < x < \alpha$  ( $m > 0$ ). There is 1 reference, 0 of which is Soviet.

Card 2/3

Physics Inst in P. N. Lebedev



VAVILOV, V.S.; VUL, B.M.; GALKIN, G.N.; FRIDMAN, S.A.

Performance of "atomic" sources of current with double transformation of energy. Fiz.tver.tela 1 no.5:826-827 My '59.

(MIRA 1.2:4)

1. Fizicheskiy institut im. P.N. Lebedeva.  
(Semiconductors)

8(3)

AUTHORS:

Bagayev, V. S., Vul, B. M., Zherebtsova, A. A., Yuditnkiy, S. B.

SOV/105-59-10-4/25

TITLE:

Investigation of Large Germanium Rectifiers

PERIODICAL:

Elektrichestvo, 1959, Nr 10, pp 21-26 (USSR)

ABSTRACT:

This article presents the results of an investigation of large germanium rectifiers of the VG type which were made by the Vsesoyuznyy elektrotekhnicheskiy institut im. Lenina (All-Union Electrotechnical Institute imeni Lenin) (Ref 1). Figure 1 shows the section of a VG-10 rectifier. The dependence of the rectified currents upon voltage and temperature was determined at a temperature maintained constant by means of a thermostat. The saturation current was determined by measuring the direct and backward current at voltages of

$$U \approx \frac{kT}{q} \text{ and according to the}$$

backward branch of the static characteristics (Ref 4).  $U$  denotes the voltage in the p-n transition of the rectifier,  $T$  the absolute temperature,  $k$  the Boltzmann constant, and  $q$  the elementary charge. The backward branch of the static characteristics was plotted at two values of heat emission. The investigation yielded

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... is assumed to be the only reason

## Investigation of Large Germanium Rectifiers

SOV/105-59-10-4/25

the following results: (1) The rectified current  $I_d$  exhibits a sufficiently large section on the static characteristics for which formula (1) holds. The deviations from this formula occurring at increased current densities result from the occurrence of the electron component of the rectified current, which in turn leads to an additional voltage drop and additional losses. The temperature coefficient of the rectified current in the experiments is in good agreement with that of calculations. It is about 3% for the group of rectifiers under discussion. (2) The saturation current calculated according to the formula (see Table 3) is somewhat higher than those obtained by experiment. (3) The differential capacity of p-n transitions of the investigated rectifiers is inversely proportional to the square root of the voltage applied. This indicates the gradual character of the p-n transitions. (4) The backward currents increase monotonously with increasing backward voltage. (5) The pulsed breakdown voltages of the individual rectifiers approximately agree with those to be expected from the specific resistance of germanium foils. Formula (11) yields excessively high breakdown voltages if the heating of the rectifier is assumed to be the only reason

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Investigation of Large Germanium Rectifiers

SOV/105-59-10-4/25

for the increase in the backward current. Formula (13) holds for the overheating of the diode when breakdown occurs, which approximately agrees with the experimental results. There are 7 figures, 6 tables, and 7 references, 4 of which are Soviet.

SUBMITTED: May 11, 1959

Card 3/3



24(3)

AUTHORS:

Basov, N. G., Vul, B. M., Popov, Yu. M.

SOV/50-37-2-54/56

TITLE:

Quantum-mechanical Semiconductor Generators and -Amplifiers of Electromagnetic Oscillations

PERIODICAL:

Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 2(8), pp 587-588 (USSR)

ABSTRACT:

In the present "Letter to the Editor" the authors discuss the possibility of using the electron transitions between the conductivity zone (valence zone) and donor (acceptor) impurity levels of a semiconductor for the production of electromagnetic radiation (like in a molecular generator). For the realization of semiconductor generators and -amplifiers it is necessary to provide for such a distribution of electrons (holes) in the conductivity zone (valence zone) that the effective temperature of the conductivity electrons (holes) is negative with respect to the ionized donors (acceptors). Such a semiconductor has negative frequency losses in the case of transitions of electrons (holes) from the conductivity (valence) zone to impurity levels. If such a semiconductor is irradiated with electromagnetic waves, the latter may be amplified; if certain conditions (self-excitation)

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Quantum-mechanical Semiconductor Generators and  
-Amplifiers of Electromagnetic Oscillations

SOV/56-37-2-54/56

are satisfied, such a device may work as generator. In order to attain negative temperatures, a special impurity ionization mechanism is suggested. This state with negative temperature is maintained during the relaxation time of electrons (holes) with the impurity levels. If the number of impurities is small compared to the number of atoms in the crystal lattice, the life time of the conductivity electrons (holes of the valence zone)  $\tau_2$  is large compared to the time  $\tau_1$  between the collisions of electrons (holes) with the lattice.  $\tau_2$  may be regulated by the impurity concentration. During the period  $\tau_2$  the system may be used as a generator or as amplifier of electromagnetic oscillations. A reduction of the surface

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Quantum-mechanical Semiconductor Generators and  
-Amplifiers of Electromagnetic Oscillations

SOV/56-37-2-54/56

reflection coefficient or of the dimensions of the sample may  
convert the system from the function as generator to that of an  
amplifier. The present paper was registered by the Committee  
of Inventions and Discoveries of the USSR Council  
of Ministers with priority of July 7, 1958.  
There are 3 Soviet references.

ASSOCIATION: Fizicheskii institut im. P. N. Lebedeva Akademii nauk  
(Physics Institute imeni P. N. Lebedev of the Academy of  
Sciences)

SUBMITTED: May 18, 1959

Card 3/3

66470

~~24(3), 2(3)~~ 24.7700

SOV, 20-129-1-16/64

AUTHOR: Vul, B. M., Corresponding Member, AS USSR

TITLE: On p - n Transitions at Low Temperatures

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 129, Nr 1,  
pp 61 - 63 (USSR)

ABSTRACT: At sufficiently low temperatures, the concentration of the electrons in the conduction zone and the concentration of the holes in the valence zone becomes very small in comparison to the concentration of the admixture, assuming, that  $W_i \ll kT$  holds for the ionisation energy of the admixture in the semiconductor ( $k$  = Boltzmann constant,  $T$  = absolute temperature). At low temperatures the effect of the electrons and holes on the formation of space charge of the p - n transition may be neglected. In this case the following equation for the potential distribution in a step-like p - n-transition in dimensionless quantities is obtained for the one-dimensional problem with lacking degeneration:

$$\frac{d^2 \psi}{d\xi^2} = - \frac{v_d}{1+e^{-\beta+\psi}} - \frac{v_a}{1+e^{-\beta-\psi}} \quad \text{if } \xi \gg 0$$

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SOV/20-129-1-16/64

On p - n Transitions at Low Temperatures

$$\frac{d^2 \psi}{d\xi^2} = - \frac{v_d'}{1+e^{-\beta+\psi}} - \frac{v_a'}{1+e^{-\beta-\psi}} \quad \text{if } \xi \leq 0. \text{ The units are}$$
  
 defined as follows: Unit of potential  $\psi = kT/q$ , unit of length  $\xi =$  Debye length, unit of concentrations  $v_d'$  and  $v_a'$  ( $v_d'$  and  $v_a'$ ) of the donors, and the acceptors respectively in an electronic semiconductor (hole-semiconductor) = intrinsic concentration of the electrons  $n_i$ .  $\epsilon$  denotes the dielectric constant,  $q$  the unit charge. Furthermore it holds that  $\beta = (g-2W_1)/2kT$  ( $g =$  width of the forbidden zone of energies) and  $W_1$  is assumed to be equal for both donors and acceptors. The first terms of the above described two equations correspond to the ionized donors and the second terms to the ionized acceptors. These terms depend on the distribution of the potential in the present case. It was found:

$$\frac{v_d - v_a}{v_a} = \frac{\alpha(e^{v_d'} - e^{-\psi_d})}{1 + \alpha e^{-\psi_d}}. \quad \text{Here it holds that } \alpha = e^{-\beta} \text{ and } \psi_d$$

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denotes the value of the potential  $\psi$  for  $\xi \rightarrow \infty$ . In germanium,

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On p - n Transitions at Low Temperatures

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$\psi_d = \beta$  for  $\xi \rightarrow \infty$ ,  $\psi_a = -\beta$  for  $\xi \rightarrow -\infty$ ,  $\psi_d - \psi_a = 2\beta$ , is valid with great accuracy. The solution of the first of the above-mentioned two equations runs as follows:

$\frac{d\psi}{d\xi} = \left[ \alpha - 2\nu_d \frac{e^\psi}{1+e^{\psi-\beta}} + 2\nu_a \ln(e^{-\beta} + e^\psi) \right]^{1/2}$ . By taking into account the condition  $d\psi/d\xi = 0$  for  $\xi \rightarrow \infty$  it is found that

$\frac{d\psi}{d\xi} = 2^{1/2} [\nu_d \beta - \nu_d \psi + \nu_d \ln(1+e^{\psi-\beta}) + \nu_a \ln(e^{-\beta} + e^\psi)]^{1/2} \approx [2\nu_d(\beta-\psi)]^{1/2}$ . In similar way one gets

$\frac{d\psi}{d\xi} = [2\nu_a'(\beta+\psi)]^{1/2}$  for  $\xi < 0$ . After some steps of computation:

$\psi(\xi) = \beta - (\sqrt{2}\beta - \sqrt{(\nu_d/2)}\xi)^2$  is obtained. Therefore the complete potential difference belongs practically to the range  $\xi > 0$  for  $\nu_a' \gg \nu_d$  and the width of the p - n transitions extends from  $\xi = 0$  to that value  $\xi = \xi_a$  for which  $\psi = \beta$ . For the potential

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difference at the transition, caused by diffusion,

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On p - n Transitions at Low Temperatures

$U_d = (g - 2W_1)/q \sim g/q$ . For  $g$  measured in eV  $U_d$  in V is numerically equal to the forbidden zone of energies. The width of the p - n transition amounts to

$h = (g - 2W_1)^{1/2} \xi^{1/2} / q(2\pi N_d)^{1/2}$  in the absence of external voltage.

At low temperatures most of the admixtures are almost completely ionized in the zone of the p - n transition. The results of the present paper were confirmed by investigations of the capacity of p - n transitions at low temperatures. There are 4 Soviet references.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR  
(Institute of Physics imeni P. N. Lebedev of the Academy of Sciences, USSR)

SUBMITTED: August 1, 1959

Card 4/4

VUL, B.M. and VAVILOV, V.S.

"The Capacitance of p-n Junctions at low (helium) Temperatures."

report submitted to the MIT Physical Electronics Conference, 24-26 March 1960.



VUL, B.M. and VAVILOV, V.S.

"Effect of Strong Electric Field on the Absorption Edge in  
Silicon and on the Recombination Properties of Structure  
Defects in Silicon."

report submitted to the MIT Physical Electronics Conference, 24-26 March 1960.



86450

9,4330 (also 1043)

S/181/60/002/011/040/C42  
B006/E060

26.1631

AUTHOR: Vul, B. M.

TITLE: Impact Ionization and Tunnel Effect in Semiconductors

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 11, pp. 2961-2967

TEXT: The present paper offers a discussion, based on theory, of the impact ionization in p-n junctions, of low-temperature breakdown, and of the tunnel effect in p-n junctions. The first publications in this field are by A. F. Ioffe. It is pointed out that the elementary theory of impact ionization in semiconductors is in a certain way simpler than in gases, this being chiefly due to the fact that in gases the two partners concerned - electrons and ions - have a very different mobility, whereas it is practically the same in semiconductors (electrons and holes). On the basis of the Townsend theory, the condition  $\int_0^h \alpha dx = \ln k/(k-1) = \text{const}$  must be satisfied for the breakdown of a p-n junction;  $k = \beta/\alpha$ ;  $\alpha$  - coefficient of impact ionization of an electron,  $\beta$  - that of a hole. The maximum electric field strength  $E_{\text{max}}$  at the junction is equal to  $2u/h$ , where  $u$  is

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S/181/60/002/011/04C/042  
B006/B060

# Impact Ionization and Tunnel Effect in Semiconductors

the voltage at the junction and  $h$  the thickness of the junction layer. The  $\alpha$ -values obtained theoretically and experimentally are intercompared in tables for different  $E$ -values. The following was obtained for germanium:  $\alpha = 10^{-25} E^{5.5} \text{ cm}^{-1}$ , and  $\beta = 2 \cdot 10^{-25} E^{5.5} \text{ cm}^{-1}$ , while for silicon  $\alpha = 1.4 \cdot 10^{-22} E^{4.7} \text{ cm}^{-1}$ , and  $\beta = 0.31 \cdot 10^{-22} E^{4.7} \text{ cm}^{-1}$ . Hence the dependence of impact ionization on the field strength is more strongly marked in germanium than in silicon. At temperatures near the absolute zero point, impact ionization may be also observed in homogeneous semiconductors. If the most favorable conditions for impact ionization are provided in, say, germanium, i.e., low ionization energy (which is only about  $10^{-2} \text{ eV}$  for impurities of the 3rd and the 5th group in Ge) and a large mean free path an impact ionization may be brought about already at exceedingly low field strengths (some  $\text{V/cm}$  in Ge). The current density as a function of  $E$  for homogeneous p-type germanium is shown in Fig. 2, based on data by Zavaritskaya. The curve shows that impact ionization appears at about  $5 \text{ V/cm}$ , while at  $20 \text{ V/cm}$  the impurities are practically ionized completely. The ionization of impurities took place solely by holes at this low-temperature breakdown (in n-type, analogously, by electrons only).

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Impact Ionization and Tunnel Effect  
in SemiconductorsS/181/60/002/011/040/042  
B006/B060

The possibility is finally discussed of explaining the breakdown of a p-n junction by the tunnel effect. The position of the Fermi levels and the characteristics of an Esaki diode are discussed in great detail. Fig. 3 shows the position of the Fermi levels for a p-n junction in a degenerate semiconductor with thermal equilibrium (a), a maximum direct current (b), and a minimum direct current (c). Fig. 4 illustrates the dependence of the current on the voltage at a tunnel diode on the basis of data by A.P. Shotov. I. I. Ivanchik calculated a p-n junction in a degenerate semiconductor. L. V. Keldysh and V. A. Chuyenkov are mentioned. There are 4 figures, 3 tables, and 11 references: 8 Soviet, 1 British, and 2 US. ✓

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva  
(Institute of Physics imeni P. N. Lebedev AS-USSR, Moscow)

SUBMITTED: August 4, 1960

~~Legend to Fig. 4: 1) reverse branch, 2) direct branch, n) impurity concentration~~

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VUL, B.M.; ZAVARITSKAYA, E.I.

Capacitance of p - n junctions at low temperatures. Zhur. eksp. i  
teor. fiz. 38 no.1:10-17 Jan '60. (MIRA 14:9)  
(Materials at low temperatures) (Junction transistors)

S/053/60/C71/004/004/004  
B004/B056

AUTHORS: Vul, B. M., Konorova, Ye. A., Demeshina, A. I.

TITLE: Georgiy Ivanovich Skanavi (Deceased)

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol. 71, No. 4,  
pp. 681 - 685 ✓

TEXT: On November 11, 1959 G. I. Skanavi, a prominent Soviet research scientist in the field of dielectrics died. He was Head of the laboratoriya fiziki dielektrikov Fizicheskogo instituta im. P. N. Lebedeva AN SSSR (Laboratory of Physics of Dielectrics of the Institute of Physics imeni P. N. Lebedev of the AS USSR) and Professor of the moskovskiy gosudarstvennyy universitet im. Lomonosova (Moscow State University imeni Lomonosov). Skanavi finished his studies at the Leningradskiy politekhnicheskii institut (Leningrad Polytechnic Institute) in 1931, and began working at the plant "Elektrosila", where he had already given proof of his abilities of a research worker in the works laboratory. In 1935 he entered the Nauchno-issledovatel'skiy institut radiopromyshlennosti (Scientific Research Institute of the

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Georgiy Ivanovich Skanavi (Deceased)

S/053/60/071/004/004/004  
B004/B056

Radio Industry), and in 1940 he began his activities at the Institute of Physics imeni B. N. Lebedev of the AS USSR, first in the capacity of senior scientific worker, and later as deputy of the Head of the elektrofizicheskaya laboratoriya (Electrophysical Laboratory), and since 1954 as Head of the Laboratory of the Physics of Dielectrics, which became the leading laboratory in this field of the Soviet Union. The first works (1931-1935) of the deceased dealt with the high-voltage insulation of electrical machines. His method of removing the corona, and his method of testing insulation were used in industry. Skanavi became Candidate of Physical and Mathematical Sciences in 1937. Many of his works dealt with the dielectric losses and with polarization in glasses. Skanavi drafted the theory of relaxative losses, and discovered the neutralization- and crystallization effect of loss reduction. During the war he investigated polycrystalline dielectrics at the Institute of Physics, produced new dielectrics with a high dielectric constant, and developed a theory, which explains the high dielectric constant of crystals. It was upon these works that the Doctor's dissertation defended by him in 1946 was based. For the industrial production of ceramic capacitors developed by him, he was awarded the Stalin Prize

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Georgiy Ivanovich Skanavi (Deceased)

S/053/60/071/004/004/004  
B004/B056

in 1952. In recent years Skanavi, assisted by the collaborators of his laboratory, produced dielectrics with a particularly high dielectric constant: the strontium-bismuth-titanates. In 1958 the first strontium-titanate single crystals were obtained at his laboratory. During the investigation of the electric strength of dielectrics the photoconductivity of KBr crystals stimulated by high voltage pulses was discovered. Further, Skanavi delivered the glass substances known as "pyroceram" <sup>15</sup> with finely disperse crystalline phase and a new class of electrets. Besides his scientific activities, Skanavi was for several years the Head of the works laboratory of a radiotechnical factory in Moscow. He published more than 70 scientific works, among them the monograph "Fizika dielektrikov" in two volumes. For several years Skanavi was the scientific secretary of the Institute of Physics, and Member of the Byuro otdeleniya fiziko-matematicheskikh nauk AN SSSR (Bureau of the Branch of Physical and Mathematical Sciences of the AS USSR). Since 1944 Skanavi has been Member of the Communist Party of the Soviet Union, and since recently also Secretary of the Party Committee of the Institute of Physics. There are 1 figure and 55 Soviet references.

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87397

9,4300 (3203, 1043, 1143)  
24.7700 2407, 1035, 1135

S/020/60/135/006/012/0:  
B019/B056

AUTHORS: ~~Vul. B. M.~~ Corresponding Member AS USSR, Zavaritskaya, E. I.,  
and Keldysh, L. V.

TITLE: Impurity Conductivity of Germanium at Low Temperatures

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 135, No. 6,  
pp. 1361-1363

TEXT: At temperatures  $T \ll \epsilon_i/k$ , where  $\epsilon_i$  is the impurity ionization energy and  $k$  the Boltzmann constant, the electrical conductivity of semiconductors is very low. If the field strength is increased, the impact ionization increases, because the mean free path of the carriers is relatively great at low temperatures. As the impurity ionization energy is low (0.01 ev for the indium-doped p-type germanium considered here), impact ionization starts already at field strengths of some v/cm. The lower the temperature, the lower is the fraction of thermal ionization, as follows from the dependence of current density on field strength shown in Fig. 1. At the temperature of liquid helium, the hole concentration may be

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87397

Impurity Conductivity of Germanium at  
Low Temperatures

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B019/B056

described by:  $p = \frac{s(N_a - N_d) - rN_d}{r + s}$  (1), where  $s$  is the mean ionization probability,  $r$  the mean recombination probability,  $N_a$  the acceptor concentration, and  $N_d$  the donor concentration. As the increase in  $r$  with an increase of electron energy is much slower than that of  $s$ , the free hole concentration in the range of pre-breakdown field strength is determined largely by the exponential growth of the ionization rate. The drift rate as a complex function of field strength is discussed, and it is found that at high field strengths the sharp decrease in mobility at helium temperatures is connected with the occurrence of a large quantity of charge centers. Thereby, the fraction of Coulomb scattering in the total number of collisions per unit time increases. The authors thank V. A. Chuyenkov for a discussion. There are 3 figures and 6 references: 3 Soviet and 3 US.

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TEXT: The present paper deals with the derivation of some formulas for calculating the capacity of p-n junctions. The capacity of a p-n junction depends on the ionized-impurity distribution in it. For clarifying the principal relations, it suffices to study the simple case of a plane junction, in which the one side, e.g., the p-type, has such a low resistance that the entire resistance may be ascribed to the n-type side. In this case, the potential distribution in the junction may be described by the Poisson equation  $d^2\psi/dx^2 = -4\pi q/\epsilon$ , where  $q = f(x)$  is the volume charge density, and  $x$  is the distance of the point of reference in the n-type region from the junction surface. With the boundary conditions  $\psi(0) = \frac{d\psi}{dx}\bigg|_{x=0} = 0$ ,  $U = \psi(x)_{x=h} = \frac{4\pi}{\epsilon} \int_0^h xf(x)dx$  is the solution,

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